TOKYO 11 TH INTERNATIONAL INNOVATIVE STUDIES & CONTEMPORARY SCIENTIFIC RESEARCH CONGRESS

April 6-7 2026 / Tokyo - Japan

CONGRESS PROCEEDINGS BOOK

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Liberty Publishing House
Water Street Corridor New York, NY 10038
www.libertyacademicbooks.com
+1 (314) 597-0372

ISBN: 979-8-89695-407-1
Publication Date: 10.05.2026

PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) IN COSMETICS: OCCURRENCE, EXPOSURE PATHWAYS, HEALTH CONCERNS AND EMERGING REGULATORY RESPONSES

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ABSTRACT

Per- and polyfluoroalkyl substances (PFAS) are a large class of synthetic fluorinated chemicals increasingly recognized as persistent environmental and human contaminants (EPA, 2023; Peaslee et al., 2021). PFAS are intentionally added to many cosmetic and personal care products to enhance spreadability, water resistance, film formation, and long-lasting performance, and may also enter formulations unintentionally as impurities or degradation products of precursor ingredients (FDA, 2025; ToxStrategies, 2025). Recent analytical surveys report that a substantial proportion of foundations, mascaras, lipsticks, and other colour cosmetics sold in North America and Europe contain high levels of fluorine, suggesting widespread PFAS use (Peaslee et al., 2021; University of Notre Dame, 2024). While cosmetics are not the dominant source of aggregate PFAS exposure, their direct, frequent application to skin, lips, and peri-ocular areas raises concern, particularly for long-lasting and waterproof products marketed for daily use (Exponent, 2026; Wigle et al., 2025). Multiple epidemiological and toxicological studies link certain well-studied PFAS (for example, PFOA and PFOS) to kidney and testicular cancers, immune suppression, endocrine disruption, dyslipidaemia, and developmental toxicity, although cosmetic-specific risk assessments remain limited and uncertain (WHO, 2022; ECHA, 2023). Regulatory agencies in the United States, Canada, and the European Union are now reassessing PFAS in cosmetics under broader "forever chemical" control strategies, but current measures vary in scope and stringency and safety determinations are incomplete (FDA, 2026; ECHA, 2023). This review summarizes current knowledge on PFAS types used in cosmetics, product categories affected, exposure and toxicological concerns, and evolving regulatory responses, and highlights key research gaps relevant for risk assessment and safer-by-design formulation.

Introduction

PFAS constitute a broad family of more than 4700 synthetic organic chemicals characterized by highly fluorinated carbon chains that impart exceptional stability, oil and water repellency, and surfactant properties (EPA, 2023; OECD, 2022). These properties underpin extensive use of PFAS in industrial applications and consumer products, including non-stick cookware, food contact materials, textiles, firefighting foams, and a wide range of cosmetic products (ECHA, 2023; SGS, 2025).

In cosmetics, PFAS function primarily as emulsifiers, film-formers, and surface-modifying agents that improve slip, spreadability, durability, water resistance, and a "smooth" or "airbrushed" appearance on skin and hair (FDA, 2025; ToxStrategies, 2025). Analytical studies and product ingredient reviews indicate that PFAS can be present in colour cosmetics (foundations, concealers, lipsticks, mascaras), skincare (moisturizers, sunscreens), hair conditioners, and certain hygiene products, either as intentionally added ingredients or as impurities and degradation products (Peaslee et al., 2021; University of Notre Dame, 2024; PubMed, 2024).